THE GONOCOCCUS AS A FACTOR IN INFECTIONS FOLLOWING ABORTION OR FULL-TERM DELIVERY.

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Probably no subject of equal importance in medical science shows such diverse opinions as that regarding the cause and means of prevention of infection following the discharge of the products of conception from the uterus. Since Mayrhofer in 1863, Coze in 1869, and more especially since Pasteur in 1879, found the streptococcus in the lochia of women suffering from puerperal fever, this organism has been looked upon as the most important bacteriological factor in this disease. In consequence the attention of numerous investigators has been directed toward the presence of this coccus in the vaginal discharge of pregnant and non-pregnant women. The results of examination have not been uniform, and opinion has been varied regarding the possibility of auto-infection and the value of antepartum douches. Although many observers have proved the prevalence of gonorrhœa in modern society, few have been able to show that it is of definite importance in the production of more important forms of puerperal fever.

Experiments by Duhrssen, Bumm, and others, as well as my own observations appear to prove that the normal vaginal, cervical, and urethral epithelium is not attacked by the ordinary pyogenic cocci. When, however, the resistance of the parts is overcome by such an organism as the gonococcus, other bacteria seem able to produce their characteristic lesions. This fact, I believe, is of importance in our consideration of postpartum infections and will help, in part, to explain the diverse opinions held by various authorities upon the question or auto-infection.

The number of cases in my series is small; the results, however, are very suggestive. I believe that the careful examination of the lochia at the onset of fever would demonstrate the gonococcus in a large number of cases. It does not seem unreasonable to suppose that the streptococcus and other pathogenic organisms, which are constantly present in the rectum and the external genitals, should be ready to invade the vagina whenever an opportunity is given. The gonococcus present in the cervical glands or other part of the genital tract takes advantage of the bruised condition of the tissues after labor and sets up an inflammatory process. This process paves the way for a secondary infection by more pathogenic organisms, such as the streptococcus. These secondary invaders having gained entrance, the disease becomes more serious and presents graver symptoms.

The mortality figures of hospitals, in other ways of equal merit, do not materially differ whether douches are used during the latter days of pregnancy or not. At the same time, although the installation of aseptic methods has enormously reduced the mortality from puerperal infection, there still persists a certain number of cases occurring year by year. Many of these cases occur in women in whom labor has been spontaneous or even precipitate. Again, the mortality rate does not give an adequate idea of the incidence and importance of puerperal fever. Many patients are only saved after the most careful nursing and constant attention. Others after a severe illness for a few days are apparently cured and leave the hospital well. A still larger class run a mild fever for two or three days and are discharged after an otherwise normal puerperium. It is women of these classes who return within a few weeks or months to consult the gynecologist for inflammation of the uterine appendages, pelvic peritoneum, or the uterus itself. How rarely is a pelvic abscess or pyosalpinx found in women who have never been pregnant!

No matter what the opinion held by obstetricians regarding the value of douches in healthy women, all are of the same mind regarding the management of gonorrhœa. All admit that this condition demands active treatment. As a rule, however, the failure to carry out such treatment is supposed to result in a mild form of infection from which the patient may be expected, in the great majority of cases, to recover in a few days. The presence of the gonorrhœal condition is usually inferred from the presence of an acute vaginitis or vulvovaginitis, with redness and perhaps swelling of the vaginal walls or vulva, accompanied by a profuse creamy, greenish-yellow discharge. In the absence of such vaginitis, signs of urethritis are looked for.

The gonococcus is a much more frequent inhabitant of the vagina than such a diagnosis would lead one to believe. In a series of examinations[1] made by me of the vaginal discharge of 113 women, the gonococcus was isolated fifty-two times. These cases represent the average class of women applying for treatment for pelvic disease at hospital clinics. This group of cases consisted of 13 of acute vaginitis, from 8 of which the gonococcus was isolated; 36 subacute cases showed the gonococcus in 22; from 44 cases suffering from chronic pelvic disturbances of one kind or another the gonococcus was isolated twenty-two times; 20 cases showing no evidence of inflammation, examined as controls, showed no gonococcus. The results of this series of examinations show that the gonococcus is a common factor in the production of pelvic disease. More important, however, these experiments prove that it is possible by means of a careful technique to demonstrate this organism in the majority of cases in which it is present.

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[1] A Contribution to the Bacteriology of the Female Genital Tract, Jour. Med. Research, 1908, xviii, 291.

The method of isolation employed in the above series of cases, as well as the cases reported in this paper, is simple. The material to be examined is procured upon a sterile swab, such as is used in ordinary routine bacteriological examinations. The cervix is exposed by means of a bi-valve speculum. After thoroughly sterilizing the external genitals the cervix is cleansed with a series of sterile cotton sponges. The point of the swab is then passed through the os and thoroughly rubbed over the endometrium. A tube resembling that used by Döderlein has been used in a number of cases. This tube has shown itself to be inadequate as a means of obtaining material, as it only procures the most fluid part of the discharge which is well known to contain the bactericidal properties in largest proportions. The result has been that although numerous organisms are usually seen in the smears prepared from the fresh material, rarely is any growth effected. Within as short time as possible the material on the swab is surface seeded over blood agar. With some experience isolated colonies may be readily procured by this method. As a rule, within twenty-four to forty-eight hours, gonococci, if present, will appear as small, bluish-gray, semi-transparent colonies from 0.5 to 1.5 mm. in diameter (Fig. 1). The observer accustomed to the growth of the gonococcus and other organisms resembling

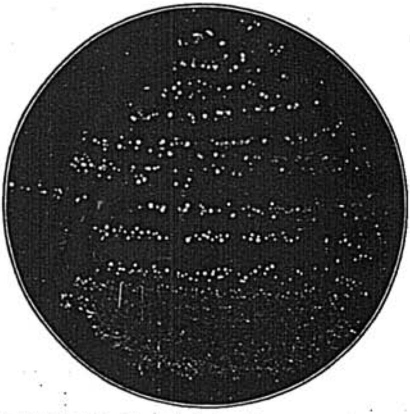

FIG. 1.—Showing the isolating of colonies of the gonococcus by the stroke methods on blood agar plates.

it will rarely be in doubt as to the nature of the bacteria when a typical growth is produced on blood agar. The results of a very complete test of the relative value of cultural methods of identification, and stained smears of fresh discharges in the above-mentioned series, show that the fresh-stained smear preparation is of little value. In the examination of uterine lochia, the fresh smear is of more help. Here also, however, no definite diagnosis can be made without cultivation of the organisms. The same features which render the examination of the fresh lochia from the uterus of more value than that of the vaginal discharge in general, that is, the larger number of gonococci usually present and the smaller number of contaminating organisms, renders the isolation in cultures correspondingly more easy.

During the past year I have had the opportunity of examining the lochia from 14 cases of severe endometritis following abortion or full-term labor. In all cases the women suffered from definite constitutional disturbances. In all the temperature rose to above 103°. Three patients died and came to autopsy; 2 others developed metastatic pyogenic processes. In addition to the 14 cases examined during life, the bacteriological factor has been determined in 6 other cases coming to autopsy. Of the 20 cases, 4 followed abortion; the other 16 were in women delivered at full term.

The organisms isolated were as follows: Streptococci, ten times in 7 fatal cases; pneumococci, twice in 1 fatal case; Bacillus aërogenes capsulatus, 1 fatal case; gonococci five times, and 1[2] four times along with the streptococcus; Bacillus coli once in almost pure culture; Bacillus coli was also found in larger or smaller numbers in practically every case. Staphylococci, both aureus and albus, were found in large numbers, and saprophytic organisms were frequently found.

In addition to the six pathogenic organisms, a Gram-negative coccus, not resembling the gonococcus either morphologically or in culture, was isolated twice.

In a certain number of cases no growth was procured. This was probably due, in a few cases, to the antiseptic douches which the patients were receiving. Four negative results were undoubtedly due to the use of a tube in the collecting of the material for examination. One of the cases which gave no growth was probably due to the gonococcus.

In my series of 20 cases there are 5 from which the gonococcus was isolated, and 1 in which it was almost certainly present. Only 1 of the cases infected with the gonococcus was fatal. Death was apparently due in this case to a secondary streptococcic infection. All patients, however, suffered from high fever and rapid pulse; 5 had chills. The onset of fever in these cases was early with the exception of 1 case following abortion (Case III); 2 cases (I and V) had a fever of 102° before removal from the confinement table. In 1 case (Case VI) the temperature rose to 102° on the second day following delivery; it returned to normal the next day, reaching 104° again on the eighth day. The remaining 2 cases developed fever on the second and fourth days respectively.

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[2] See Case II.

As is usual with all forms of puerperal infection the patients did not realize the severity of their condition. As a rule, they claimed to feel well and protested against being kept in bed. Fever lasted as a rule from one to two weeks. All patients with the exception of one (Case IV), who died, recovered strength comparatively rapidly once free from fever.

Two cases had a profuse creamy, yellow, purulent discharge. In 2 cases (Cases III and IV) the discharge was moderate or scant in amount and mucopurulent in character. Cases I and II presented the false membrane covering the vaginal walls usually associated with a streptococcic infection.

It has been found in the examination of vaginal discharges of acute vaginitis, that other pyogenic cocci such as streptococcus and pneumococcus are not infrequently present in large numbers; sometimes in such large numbers that they seem to be the only organism demonstrable. The history, subsequent examinations, or course of the disease shows in nearly all cases that the gonococcus of Neisser is the primary pathogenic factor. That a similar combination of the gonococcus with one or more pyogenic bacteria in the endometritis following childbirth occurs, certain of the following cases will prove:

CASE I.—Mrs. C. G., primipara. Bacteriological number 07.799. The patient was admitted to the Montreal General Hospital, service of Dr. Lockhart. She had been confined four days previously and was suffering from a bloody, mucopurulent discharge; her fever was high, 103.4°; her pulse, 120 (Fig. 2). The vaginal walls and vulva were covered with false membrane with numerous underlying areas of excoriation. During the last six months of pregnancy the patient had suffered from a profuse greenish, creamy discharge, with redness of the vaginal outlet and excoriations. She had been treated with douches of creolin and mercury bichloride. Before the patient was returned to bed after delivery her temperature had risen to 102°, and her pulse was very rapid. The discharge and the severity of her symptoms increased until her entry into the hospital. She was put under constitutional treatment and frequent douches, and left the hospital well on the twenty-fifth day. A smear stained by Gram's method by the doctor in charge one day postpartum contained gonococcoid organisms. A bacteriological examination of the lochia on the day after admission showed Streptococcus pyogenes present in large numbers together with a mixture of various Gram-positive and negative bacilli.

In this case, although the gonococcus was never culturally isolated, it appears justifiable in the light of the persisting acute vaginitis, apparently gonorrhœal, and the result of the smear diagnosis of the physician in charge of the case, to classify it as undoubtedly gonorrhœal in origin. At the time, however, of the patient's entry to the hospital she presented the picture of a phlegmonous vaginitis usually associated with infection by Streptococcus pyogenes. That this organism was really the cause of the severity of the patient's symptoms, the bacteriological examination proved.

CASE II.—Mrs. J. G., aged thirty-two years, primipara. Bacteriological number 07.729. The patient, three days postpartum had a chill and developed a high fever (Fig. 3) and rapid pulse with more or less profuse bloody, slightly foul-smelling discharge. Upon the fifth day postpartum she was brought to the hospital. When examined on the sixth day the whole vagina was covered with a false membrane of a foul-smelling, sloughy material. Previous to delivery there had been no evidence of any inflammatory disturbance. Delivery had been instrumental and difficult. The strictest technique had, however, been employed. Smears taken from the cervix on the second day after the chill, stained by Gram's method, showed numerous pus cells together with an enormous number of all sorts of organisms including large and small bacilli, many cocci retaining the Gram stain, and a few biscuit-shaped Gram-negative diplococci. Planted upon blood agar, a mixed growth of Staphylococcus albus and gonococcoid organisms, as well as several saprophytic organisms, resulted.

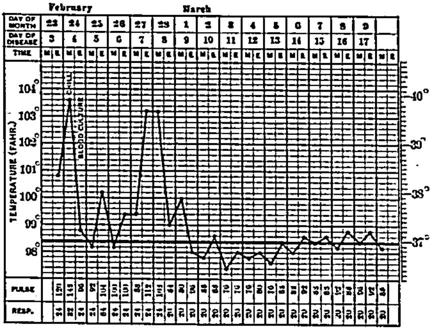

FIG. 2.—Chart of Case I.

This case has been included in the series, although the large number of contaminating organisms made a diagnosis of the gonococcus impossible.

CASE III.—Mrs. A. P., aged thirty-five years, multipara. Bacteriological number 07.686. The patient was admitted to the hospital

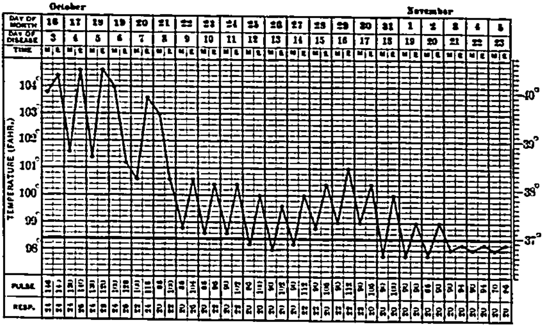

FIG. 3.—Chart of Case II.

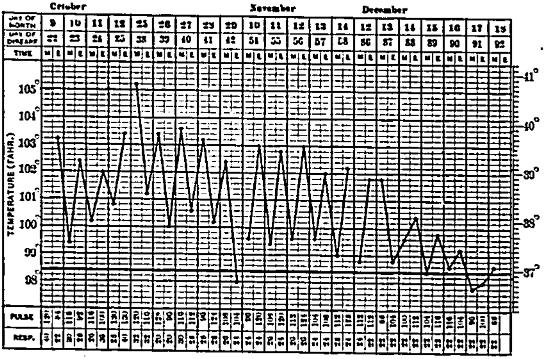

FIG. 4.—Chart of Case III.

suffering from pain in the right leg and arm (Fig. 4). She had a scant, bloody, purulent, uterine discharge. There was no tenderness in the pelvis. The condition in the leg developed into a definite femoral phlebitis. The right wrist became the site of a septic arthritis. Three weeks prior to admission the patient had aborted, giving birth to a four months' fœtus. She had remained in bed two days following the miscarriage. She continued to lose blood for over two weeks, when she developed a fever and a feeling of malaise. She was curetted, but her condition did not improve. She had had four full-term children, the youngest being ten years old. Up to the present abortion she had had but scant leucorrhœal discharge and no other symptoms of pelvic disturbance.

Bacteriological examination of the uterine discharge, one day after admission, showed numerous pus, few epithelial cells. Many Gram-negative cocci were seen occurring in pairs both inside and outside cells. Numerous chains of cocci (six to ten) retaining the Gram stain, were also seen. Planted on blood agar, in twenty-four hours there was a profuse, raised, semi-transparent growth of grayish colonies, measuring from 0.5 to 1.5 mm. in diameter. Stained by Gram's method these colonies showed Gram-negative, bean-shaped diplococci in pairs and fours. A very few colonies of fine dark points made up of Gram-positive cocci in chains were also seen. Blood cultures taken upon two occasions were sterile. Pus from several metastatic joint conditions and abscesses showed streptococci in pure culture, with absolutely no evidence of gonococci.

This case exemplifies two characteristics of gonorrhœal infection. In addition to the fact that an undoubted gonorrhœal endometritis was followed by streptococcic infection of the uterus which ultimately became general, this case demonstrates the chronicity of gonorrhœal lesions and the freedom from discomfort which the patient often enjoys. In all probability the ten years' period of sterility immediately preceding her last pregnancy had been due to what is by some considered to be the conservative salpingitis which protects women suffering from gonorrhœal infection from the dangers of childbirth and pregnancy. This protection in some way being overcome, pregnancy ensued only to be followed by abortion and an almost fatal termination.

Case IV.—Mrs. L. T., widow, aged twenty-nine years. Bacteriological number 07.955. Autopsy number 08.14. The patient was admitted to the hospital, service of Dr. F. A. L. Lockhart, December 27, 1907. She had aborted at three and one-half months two days before, since when she had considerable bleeding. Before admission her temperature was 100° and her pulse 112. Six hours later these were: temperature, 104°; pulse, 30 (Fig. 5). The uterus was cleansed with the finger and lightly with a sharp curette, and douched with sterile saline solution. A large piece of foul-smelling chorionic tissue was removed. Microscopically this tissue showed numerous polymorphonuclear leukocytes. From December 28 to January 9 the patient's temperature was septic in type, and during this time she suffered from chills of more or less marked severity. She complained of but little distress always replying when asked regarding her condition, "je me porte mieux." She suffered from very rapid respirations and at one time had a sharp attack of dyspnœa with cyanosis and gasping. On January 9, 1908, a mass was palpable to the left of the uterus. A vaginal incision was made under spinal anesthesia and a small quantity of pus evacuated. An abdominal incision was made and the left ovary, which was filled with pus, was removed. The patient's condition, however, did not improve and she died January 10, 1908. Two examinations were made of the uterine discharge. (B. 07.955.) Stained by Gram's method the fresh pus shows numerous pus, few epithelial cells. A small number of Gram-positive cocci were seen, mainly in pairs. There were numerous Gram-negative bacilli with rounded ends, for the most part occurring singly. Moderate numbers of diplococci gonococcoid in shape, decolorizing by Gram's method were seen both inside and outside cells. Planted upon blood agar, no growth occurred at the end of forty-eight hours. The failure to obtain a growth was undoubtedly due to the antiseptics used in the douches.

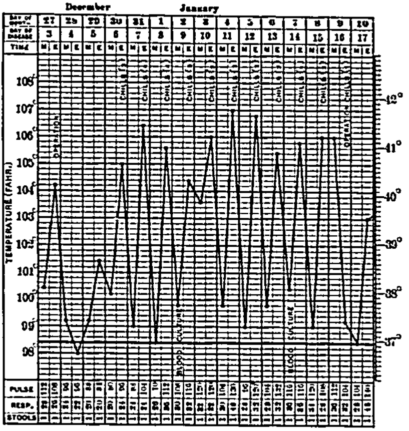

FIG. 5.—Chart of Case IV.

Second examination (B. 08.8): Stained by Gram's method the fresh pus showed large numbers of pus cells. Numerous Gram-positive cocci in pairs and chains of four were seen. Many Gram-positive and negative bacilli were found. There were also a few pairs of well-formed, biscuit-shaped, Gram-negative cocci. Planted upon blood agar, in twenty-four hours the surface was moderately covered with isolated colonies of Bacillus coli; fine colonies of Gram-positive cocci in pairs; and two fine, grayish, semi-transparent colonies, 1 mm. in diameter, of gonococci. During the course of the disease blood cultures were attempted upon two occasions, but proved negative. Autopsy was performed sixteen hours after death. The anatomical diagnosis was: Acute diffuse peritonitis; puerperal septicemia (streptococcus); acute gangrenous endometritis; multiple abscesses of uterus; phlebitis with thrombosis of peri-uterine veins; multiple pelvic abscesses; acute vaginitis; acute suppurative oöphoritis; acute suppurative nephritis; œdema of the lungs; fatty liver; healed gummas of the liver; chronic pulmonary tuberculosis; chronic pleuritis; chronic pericarditis; acute splenitis; congestion of the liver and kidneys; laparotomy; salpingectomy; vesesection; vaginal section.

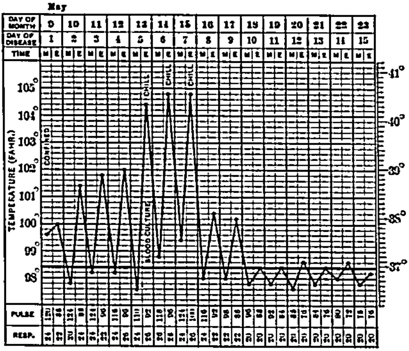

Fig. 6.—Chart of Case V.

Case V.—Mrs. D. D., aged thirty-two years. Bacteriological number 07.289. The patient was delivered in the Montreal Maternity Hospital of a full-term child. Labor was normal. From the time of delivery the patient suffered from a fever of 100° or more. On the fifth day postpartum she had a chill and the temperature rose to 104.2° (Fig. 6). She complained of little pain and no distress. The uterus involuted well, although a profuse, creamy, greenish-yellow discharge developed. No interference was attempted with the exception of one intra-uterine douche and repeated vaginal douches. The patient left the hospital apparently well. The child, however, developed a severe ophthalmia neonatorum which led eventually to septicemia and death. On questioning the husband it was found that he was being treated for kidney disease. This was found, on examination, to be a case of frank, acute, gonorrhœal urethritis. Smear shows numerous pus, few epithelial cells. Many bean-shaped Gram-negative diplococci were seen. These were situated both inside and outside the pus cells. Many cells presented a "typical" appearance, being filled with closely packed gonococcoid organisms. Planted upon blood agar, in forty-eight hours, a moderately profuse almost pure growth of gonococci developed. A similar organism was also isolated from the baby's eyes.

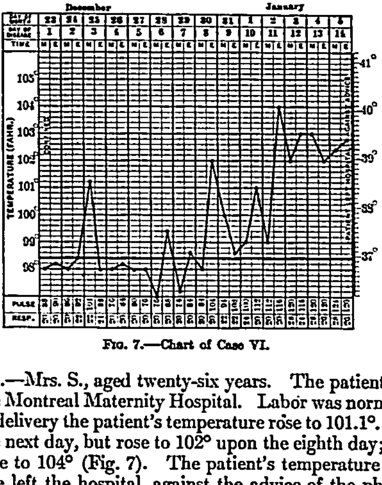

Fig. 7.—Chart of Case VI.

CASE VI.—Mrs. S., aged twenty-six years. The patient was confined in the Montreal Maternity Hospital. Labor was normal. Two days after delivery the patient's temperature rose to 101.1°. It fell to normal the next day, but rose to 102° upon the eighth day; two days later it rose to 104° (Fig. 7). The patient's temperature remained up and she left the hospital, against the advice of the physician in attendance, on the fourteenth day postpartum. The lochia consisted of a profuse, creamy, greenish, purulent discharge which persisted at the time she left the hospital. The child showed no signs of ophthalmia. No history was obtained of any antepartum inflammatory condition.

The smears showed numerous pus, few epithelial cells. Many Gram-negative bacteria with rounded ends were seen, also Gram-positive cocci in pairs. One or two pairs of Gram-negative bean-shaped diplococci were also found. In twenty-four hours a culture upon blood agar showed several large, isolated, greyish, creamy colonies of Bacillus coli; also a few white colonies of Staphylococcus albus. Between these larger colonies numerous small, semi-transparent colonies of gonococci were seen.

CASES V and VI demonstrate the severity of the disease which an uncomplicated gonorrhœal infection may produce. The unfortunate ending, too, of the ophthalmia in the child from Case V also brings before us the importance of the gonococcus in the pregnant and puerperal woman.

Although Case II was probably gonorrhœal, I will, for the purpose of this paper, speak only of the other 5 cases. In all of these the infective process began as a gonorrhœal condition. In all the most careful technique had been followed during delivery. Nevertheless 5 patients became septic and ultimately suffered from severe infection. In 3 this infection was undoubtedly due to streptococci.

All physicians dealing with large numbers of pregnant women have seen cases in which fever, at times severe, has followed spontaneous or precipitate labor, in which absolutely no examination of the internal parts had been made. Experience shows, also, that it is in unmarried girls that fever is most frequently met with. It is naturally in women illegitimately pregnant that gonorrhœa is most frequently found. Cases such as these influence Lenhartz and others to support the prophylactic douche. Many cases occur in which retained secundines, filth of the external parts, and other causes are insufficient to explain the development of the infective process.

In 1898 Burr, in an article entitled "Gonorrhœa as a Factor in Puerperal Fever," puts the question which he proceeds to answer: "Notwithstanding advancement along the lines of antiseptics, etc. . . . why is there not greater freedom from septic puerperal infection?" He draws attention to the prevalence and chronicity of gonorrhœa and states the idea, which I have expressed above, in the following words: "The gonococcus will share its possessions in apparent harmony with other pathogenic germs, or at an indefinite period quit the field in their favor."

My own experience, as well as those of many observers, seem to prove that streptococci are rarely found in the upper part of the vagina. The streptococcus, as well as numerous other organisms, is, however, undoubtedly present in the lower part of the vagina and about the vulva. Thus different investigators have had different results owing to different technique. Williams is probably correct when he says "that in those cases (in which pathogenic organisms are found in the upper vagina) the infection is probably carried up by the instrument made use of in procuring material for examination."

Other opinions and clinical experiences, on the contrary, are due, I believe, to the fact that sufficient account has not been taken of the likelihood of auto-infection occurring in cases of chronic gonorrhœa.

CONCLUSIONS. (1) The gonococcus either alone or as a primary infecting agent plays a much more important role in the production of puerperal fever than is usually appreciated by most observers; (2) various microörganisms especially the streptococcus and Bacillus coli are usually present about the vaginal outlet, although apparently infrequently found in the upper part of the vagina of the healthy woman. These organisms are ever ready to attack the tissue whose resistance has been destroyed by the action of the gonococcus. As corollaries there follow (*a*) the necessity for the most careful examination of the history of the patient and of the vaginal discharge early in pregnancy in all cases presenting the least grounds for suspicion; (*b*) the necessity for more than ordinary caution in examining externally all pregnant women presenting even the slightest evidence of an inflammatory condition.

I wish to express my thanks to Dr. F. A. L. Lockhart for use of cases in the Montreal General Hospital, as well as the physicians of the Montreal Maternity Hospital for notes upon cases in that institution. I wish also to thank Dr. C. W. Duval for numerous suggestions from time to time.

A NEW METHOD OF STAINING THE DIPHTHERIA BACILLUS.

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THE following are the materials required in a new staining procedure: Grübler's methylene blue; Grübler's eosin," W. G.," or "rein;" tartaric acid; alcohol, 96 per cent.; and distilled water.

The solutions should be prepared as follows:

(*a*) Saturated aqueous solution of methylene blue, filtered, 10 c.c.; tartaric acid, 10 per cent. aqueous solution, 10 c.c.; distilled water, 80 c.c.

(*b*) Tartaric acid, 10 per cent. aqueous solution, 10 c.c.; alcohol, 96 per cent., 50 c.c.; distilled water, 40 c.c.

(*c*) Eosin, saturated aqueous solution, filtered, 1 c.c.; distilled water, 199 c.c.

Stain thin films—on a coverglass or slide, fixed by the flame in the usual way—ten seconds in *a;* wash ten seconds in *b;* stain ten seconds in *c;* blot and dry. The solutions *b* and *c* should be poured on freely. Drying or washing in water between the different steps is unnecessary.

The polar bodies will be stained deep violet-blue; the remainder